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Innovation processes: Which process for which project?

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ABSTRACT

The innovation process has traditionally been understood as a predefined sequence of phases: idea generation, selection, development, and launch/diffusion/sales. Drawing upon contingency theory, we argue that innovation process may follow a number of different paths. Our research focuses on a clear theoretical and managerial question, i.e., how does a firm organize and plan resource allocation for those innovation processes that do not easily fit into traditional models. This question, in turn, leads to our research question: Which configuration of innovation processes and resource allocation should be employed in a given situation, and what is the rationale behind the choice? Based on a large-scale study analyzing 132 innovation projects in 72 companies, we propose a taxonomy of eight different innovation processes with specific rationales that depend on a project's contingencies.

1. Introduction

Research and practice in innovation management have been deeply influenced by certain reference models that play different roles simultaneously, such as setting an objective to be achieved, establishing a mindset, influencing decisions (even if implicitly), and indicating good management practices. Utterback (1971) was a pioneer in modeling innovation processes as a single managerial process that consists of a set of the following primary activities: idea generation; problem solving, from which the output is an original technological solution or an invention; implementation, from which the output is market introduction; and diffusion, which aims to make a significant economic impact. Several researchers have derived particular sets of activities for their models. Focusing on the auto industry, Clark and Fujimoto (1991) proposed an organizational framework (heavyweight manager and other contributions) for innovation processes. Wheelwright and Clark (1992) introduced the idea of the development funnel. Cooper (1990, 1993, 2008) and Cooper et al. (1997, 2002) proposed that the product development process might be represented as a stage-gates sequence, which later became an influential model in innovation management.

These models and their followers were originally proposed for new product development (NPD), and they consider the innovation process to be a linear sequential flow of predefined phases: idea generation, idea selection (screening), development, and launch to the market. For instance, the titles of Cooper's (1993, 2008) papers explicitly use the words “from idea-to-launch”, which suggests that “idea generation” starts the process and “launch” ends it.

However, several authors have demonstrated their disillusionment with this *one-size-fits-all* approach, primarily from the project management field (Shenhar, 2001; Andres and Zmud, 2001; Shenhar and Dvir, 2007; Kok and Biemans, 2009; Sauser et al., 2009). For instance, Shenhar (2001) argued that there is no single approach for project management that fits all cases. Additionally, studies of the initial planning for academic spin offs (Vohora et al., 2004; Gomes and Salerno, 2010) and exploratory studies conducted in other companies have suggested that many companies successfully employ different types of innovation processes. This preliminary research indicated to us that Shenhar's perspective may be applied to the management of innovation processes, which would indicate that arrangements other than “idea generation – selection/development – launch” are possible and desirable.

These previous insights from real cases inspired us to conduct a research project that focused on the following question: Which innovation processes best fit different types of projects? More specifically, what would be a typology of innovation processes, and what would be the rationale for each type of process?

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The traditional models have focused on large companies with established R&D departments and time-consuming projects that require significant resources to be developed over months or years and that typically produce durable goods. These models do not adhere to other types of important projects, such as those with a high degree of uncertainty and complexity, which are typical of radical innovation that involves new technological breakthroughs and/or new markets. Pich et al. (2002) and Rice et al. (2008) argued that this environment calls for new models, tools, and management techniques. In this way, our contribution consists of proposing a set of pertinent processes that depend on the specific characteristics of the innovation project.

To respond to our research question, we incorporate the contingency theory proposed by Lawrence and Lorsch (1967) and Thompson (1967)—with roots in Woodward (1965)—as the anchor for our scientific inquiry. This theory holds that the way to organize a business depends on the nature of the environment in which the organization is situated. We interpret the contingency approach as a way to cope with uncertainty; in classical terms, this primarily indicates technological and market uncertainties. Employing this theory with process(es) of innovation, we conducted case studies using 132 real innovation projects and analyzed the flows, characteristics, and contingencies that explain the rationale of each project. Our primary goal is to improve the current literature on innovation management by proposing a categorization of innovation processes and contingencies that explain their rationale. We move a step ahead of mere criticism of the rigidity of mainstream models by identifying alternative innovation processes from large-scale empirical research and thereby add to the knowledge about innovation management.

2. Literature review

Traditional models for managing innovation have focused on new product development (NPD) activities. Developing products involves engaging in a bundle of activities, including managing and transforming resources, gathering information and expertise on specifications and creating products that meet (or create) market demand (Wheelwright and Clark, 1992).

The literature in the field is vast: a search in the Web of Knowledge database on December 22, 2013, showed 7510 records for the topic "product development" and "management"; the number of records in the Scopus database were 15,328 (article title, abstract, keywords). Authors have explored a variety of topics related to NPD. For example, Cooper et al. (2002) argued that the most successful companies in NPD employ formal processes with well-defined decision-making criteria. In this sense, a number of new product development process (NDP) models have been proposed in the literature. Cooper (1990, 1993) proposed the idea of well-defined stages and decision points for conducting development projects (stage-gates), which was further improved by Cooper et al. (2002) and Cooper (2008). Wheelwright and Clark (1992) proposed the development funnel model; this model is characterized by many ideas conforming to a large entry and a funneling process that progressively selects projects instead of merely tunneling them through phases. Other topics related to product development have also been treated in the literature; for instance, Brown and Eisenhardt (1995) performed a broad literature review of the organizational issues related to project development, and there is also a vast literature on concurrent engineering and project management.

Nevertheless, as noted by Krishnan and Ulrich (2001), the various approaches to product development management typically focus on a single theme or area (primarily on marketing, organization, engineering projects, and operations management) and do not discuss the relationships among these themes or areas. In that sense, Fernández et al. (2010) focused on how functional units impact new product performance based on a technological turbulence framework. Knudsen and Mortensen (2011) discussed the negative effects of openness on product development performance. Sarpong and Maclean (2012) shed light on the role of product innovation teams in mobilizing the different visions of organizational stakeholders. Kahn et al. (2012) analyzed the best practice of new product development and emphasized the importance of strategy on NPD efforts. Killen and Kjaer (2012) proposed a framework for modeling project interdependencies in project portfolio management. Lowman et al. (2012) explored the risk of outsourcing in pharmaceutical new product development. Gassmann et al. (2012) proposed a framework for integrating separated explorative activities in current business units of firm. Akgün et al. (2012) investigated the sensemaking capability of new product project teams. Leon et al. (2013) analyzed how iteration front-loading may improve new product development performance. Killen and Hunt (2013) built a framework for developing capabilities related to portfolio management. Yao et al. (2013) employed repeated real options to explore the impacts of technical and economic uncertainties on product development. Ignatius et al. (2012) showed the influences of technological learning on NPD performance. Eling et al. (2013a) investigated the impact of the cycle times on new product performance. Cankurtaran et al. (2013) employed a meta-analysis approach to address the speed of new product development, following Griffin's research trajectory on cycle time. Eling et al. (2013b) developed a conceptual framework for understanding the role of intuition on decision making during the execution of fuzzy front end. De Clercq et al. (2013) used the contingency approach to investigate contextual ambidexterity and firm performance. Pérez-Luño and Cambra (2013) showed that relationship among market orientation and the incremental and radical generation and adaptation of innovations. Wang and Li-Ying (2014) studied the relation between NPD performance and inward technology licensing.

These studies also do not address instances of product design with significant uncertainty or complexity (Pich et al., 2002; Sommer and Loch, 2009). Kim and Wilemon (2003) performed a comprehensive review of the literature on various definitions of complexity (including the number of components, their interaction, the degree of product innovation, and the number of disciplines and areas involved in the project) and suggest that the sources of complexity derive from technology, markets, developmental levels, marketing, and organizational dynamics; we will use these sources as the starting point for our field investigation.

Other works have proposed a more comprehensive view of innovation process and its management. Goffin and Mitchell (2010) proposed the Pentathlon framework, a five-dimensional model for innovation management. Hansen and Birkinshaw (2007) proposed the idea of the innovation value chain, in which the NDP is an important activity, but there are other equally important activities before it, parallel to it and after it, such as idea generation, selection/conversion, and diffusion. Moreover, Hansen and Birkinshaw (2007) sought a degree of integration among traditionally isolated approaches and proposed organizational forms that enable teams and middle managers to develop ideas and even build prototypes without prior authorization by a board or committee. For example, products such as Post-It Notes, which were previously rejected by 3M's marketing department (3M, 2002), would not have made it to the market without the possibility of "prior development of ideas". This approach breaks the linear models/chains of decision making through which ideas must be approved to be further developed, which is suggested by the funnel and stage-gates models. However, one important

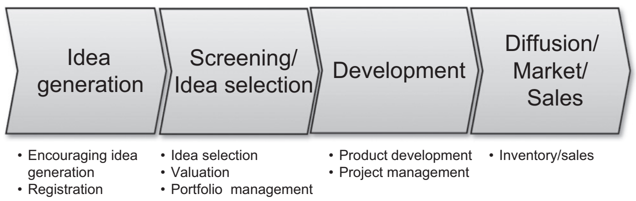

Fig. 1. Traditional linear process: from idea to launch.

limitation of the study of Hansen and Birkinshaw (2007) is that their study focused upon the large divisionalized multinational company as its paradigm. This strategy does not apply well to smaller or single-unit companies, which indicates that the type of companies to be studied should be expanded; thus, the present study is not restricted to large established firms.

Nevertheless, these authors all adopted the same traditional representation of the innovation process with the fixed sequence proposed by Utterback (1971), Wheelwright and Clark (1992), and Cooper (1990, 1993) and followed by the line of studies discussed above. To some extent, both the NPD and the innovation management authors adopt the one-size-fits-all approach.

Based on the terminology and pictorial representation of Hansen and Birkinshaw (2007), this traditional flow is generically represented by Fig. 1.

In line with the one-size-does-not fit all approach in project management discussed in the introduction of this paper, literature on the sources of innovation and innovation policies presents some insights for questioning the fixed linear sequence of the traditional models. For instance, Rothwell (1992) identified five generations of industrial innovation models, the first ones being linear, discussing technological push and market (or need) pull, and the fourth and fifth ones shifting from linear to largely parallel, involving inter-company networks. In the innovation management field, some authors have proposed comprehensive approaches regarding innovation management.

Considering projects as temporary organizations with specific goals (Shenhar, 2001), it is reasonable to suppose, based on contingency theory, that innovation projects may assume specific process configurations to address specific situations and contingencies. In that sense, we will seek to identify different pertinent configurations of the innovation process in the empirical research.

In the next section, we will describe our research methodology and field study.

3. Methodology

3.1. Research design

The purpose of this research is to identify new configurations of innovation processes other than the traditional one (largely recognized by the literature) and the rationale of each type of process. The research aims to develop the theory of innovation processes. In that sense, following Eisenhardt (1989), Yin (1994), Voss et al. (2002), and Eisenhardt and Graebner (2007) recommendations, we employed the multiple-case-studies approach. There is a tradition on multiple-case-studies approach in studies on product development (for instance, in the 1990s Clark and Fujimoto, 1991; Wheelwright and Clark, 1992; Cooper 1993, and others).

The unit of analysis is the innovation process, rather than the company. This choice is made because a company may have different innovation processes. This fact is reinforced, for instance, by the literature on the ambidextrous organization, which distinguishes between incremental and radical innovation structures in the same company (Bessant et al., 2005).

The research offers an analytic framework, deployed in a typology of innovation processes, validated through comparative case analysis.

3.2. Sample selection and qualification

We conducted field research on 132 product innovation projects in 72 companies, primarily in Brazil, with one in France and two in the Netherlands. In our sample, we investigated companies with different characteristics, such as sector (including hospitals, engineering consultancy, and R&D services), size (TNCs and start-ups), age, and with or without a formal R&D department. The companies were selected in order to provide diversity of situations, an important issue to cover different contingencies. There is no evidence on country differentiation regarding innovation processes; there is no relevant literature discussing idiosyncrasies among countries on the matter. In the sample we have local companies (two of them in the Netherlands) but multinational companies as well, some of them with global processes (e.g., Braskem, Embraco, Embraer, Ford, Google, Iveco, Fiat, Orange, Magneti Marelli, Mahle, Oxiteno, Petrobras, and Tigre). That makes the analysis generalized globally.

Table 1 shows the main characteristics of the firms where the projects were researched. In annex, the relation of companies and projects analyzed.

There is no previous theory establishing taxonomy on innovation processes. In that sense, it is not possible to think of a predefined sample. We used the saturation concept instead (Eisenhardt, 1989). We stopped conducting new cases when a robust convergence on the same processes was achieved. By robust, we mean that we preferred to be redundant and confident with more cases than would be required in an ex-post analysis. Few multiple-case studies have involved the number of cases observed in our study. In fact, discussing more cases was important to refine and test assumptions, typologies and conclusions during our research.

3.3. Data collection

All of the interviews were face-to-face, performed by the research team. We held interviews with those responsible for innovation management (e.g., director/manager of R&D, engineering, new business, marketing, CEO, and owners) and their staff (if applicable). In some companies, we could apply a longitudinal approach, performing several interviews over a period of up to 4 years. Following the recommendations of Eisenhardt (1989), Yin (1994) and Voss et al. (2002) to control biases and distortions, a formal research protocol was built. It was consisted as an interview guide (to improve the methodological discussion in the research team), a guide to writing and analyzing cases, and triangulation topics (e.g., interviewing more than one person in a company and to further check issues by phone or e-mail). The protocol was structured as follows:

a) Objectives of the research: (i) to map the innovation value chain of each project, taking as reference the stages of the traditional linear flow shown in Fig. 1; (ii) to capture organizational and managerial aspects concerning each project studied as resources, main decisions, events that shaped the main decisions and the project flow; (iii) to raise main contingencies related to the particular process of each project.
b) Preparation before the interviews (to search available data about the company in websites, publications and other means

Table 1
Characteristics of the firms where the projects had been researched.

Firm's size	Main characteristics	Companies (% from 72 companies)	Projects analyzed (% from 132 projects)
Knowledge-based small new companies	New emerging firms. Managerial main processes in definition.	22.2	13.6
Small size	Small businesses not characterized in previous description	4.2	3.8
Medium size	Established strategies and processes	19.4	22.7
Large size	Well established business strategies and organizational processes, although they may change	47.2	52.3
Research institutes (large size)	Performing R&D (public institutes), technological assistance	7.0	7.6
Total		100	100

Companies with innovation projects investigated: 3PD, Algatex , Altus, Aquamet, Artecola, Avantium, Bematech, Bio-Manguinhos, Biotec, Brasilata, Braskem, Bry, Buscapé, CNEC, Coester, Cordoaria São Leopoldo, CTI, Deca, Delphi, Digitro, Docol, E-Brane, Ecovec, Embraco, Embraer, Engevix, Epagri, Ford, Fras-Le, Genpro, GKN, Google, Grendene, Hospital Mãe de Deus, ICE, Imaginarium, Inovax, Invitt, IPT, IVE, Iveco, KNBS, KTY, Linea Laura, LSI Tec, Magneti Marelli, Mahle, Miolo, Nanox, Natura, Nexxera, Nova Reciclagem, Odebrecht Oil&Gas, Oil-Finder, Orange, Ouro Fino, Oxiteno, Petrobras, Powertrain-FPT, Promon, Quattor, Sadia, SIM, Smar, Softplan-Poligraph, Synergon, Tamoios, Tigre, Tramontina, V2Com, VSE, Welle.

regarding products, market structure, competitors, governance, size, projects, etc.).

c) Semi-structured interview guide, containing: (i) general questions about the company and its organizational structure, historical view of innovation projects and selection of innovation project(s) to be focused on; (ii) questions about project idea generation and events before its formalization (if applicable – there were also “clandestine”, but relevant projects, operating without the consent of senior management or conducted outside the formal process of the company); (iii) events related to the conversion phase as financing, idea selection and project development.
d) Events related to diffusion to the market or among corporate units and the ways the project could feedback other projects or activities.

After the interviews, all the cases were written out and, further on analyzed by the entire team, based on the same framework.

3.4. Data analysis

Data analysis was conducted by listing all the innovation processes analyzed, comparing them to capture similarities and differences in the sequence of the main activities. Therefore, we were able to establish the taxonomy presented below. Data analysis was conducted in a recursive way: it began with the first cases and was conducted until saturation by each type of process was achieved. Following literature, we are considering that feedback in between activities does not characterize a new flow. For instance, Cooper (1990, p. 46) explicitly considers that at a gate occurs the “assessment of the quality of the project from an economic and business standpoint, resulting in a Go/Kill/Hold/Recycle decision”. In that sense, we are considering that only new sequences or new combinations of activities characterizes a new process, feedback in between activities being part of the process.

Multi-case comparison made generalization possible due to a deeper understanding of contingencies behind the projects observed beyond the diversity of contexts in which each company is immersed (O'Connor and Rice, 2013). After listing the sequence of activities in the innovation process of each case, key events related to the process were highlighted, compared and codified, seeking for commonalities and dissimilarities among the projects. As a result, some models for innovation processes were firstly proposed. With these proposals in hands, each case report has then been reviewed, checking if it could be assertively explained by one of the new models or even by the traditional one. This comparative analysis motivated a loop of refinements in models proposed until a strong convergence could be achieved. We have returned to some companies to validate the taxonomy.

4. Main findings and discussion – which process for which innovation project?

From our empirical research, we identified eight types of innovation processes. Table 2 shows the occurrence of each type in our sample. Initially, we will discuss certain general considerations and findings subjacent to the logic that drove the taxonomy we are proposing; further below, we will discuss each process. In the next section we will focus on implications for theory, practice and public policies.

These eight types of innovation processes are categorized based on four aggregated initial findings that emerged in the field research.

First, although the field cases confirmed the preponderance of the traditional process (53% of the innovation projects investigated), we also confirmed our initial assumption, i.e., that firms employ other innovation processes. Indeed, our first insight was that there were different processes in terms of structure and content, which reinforced the need for the contingency perspective adopted in our study.

The first finding is directly linked to the second finding, i.e., that there are important differences in scope among the projects studied. The entire process demanded by an innovation development may (and often does) involve several firms, each performing distinct roles and contributions along the path. Each firm faces different challenges when innovating, including different markets, technologies, clients, positions in the global value chain, and institutional environments. Therefore, the innovation process tends to be different and depends on each firm's ecosystem. These differences influence the beginning and ending points of each particular innovation process. As a consequence, each firm organizes its internal efforts to perform its role and ensure its deliverables in its own distinct manner.

In addition, there are differences among the processes in terms of the level of their formality, which does not mean that informality is associated with the absence of process. As expected, we can observe a tendency toward lower levels of formality in nascent and small firms compared to established and large companies. In some cases involving radical innovations, we found “clandestine” initiatives conducted under a high level of informality (at least during the initial development stages). This type of situation was verified even in large companies with well-defined processes for incremental innovation. Among the main reasons for the “clandestine” nature of these activities, we found that the incremental

Table 2
Occurrence of each of the eight innovation processes.

Type of innovation processes	Cases		Number of companies presenting the process [a]
	#	%	
1. Traditional process: from idea to launch	70	53.0	46
2. Anticipating sales: the tailor-made approach (open order)	8	6.1	6
3. Anticipating sales from a given client specification (closed order)	7	5.3	7
4. Process started by a call	17	12.9	12
5. Process with a stoppage: waiting for the market	9	6.8	8
6. Process with a stoppage: waiting for the advance of technology	4	3.0	4
7. Process with a stoppage: waiting for the market and for the advance of technology	2	1.5	2
8. Process with parallel activities	15	11.4	14
Total	132	100.0	

[a] As we have researched more than one project in many companies (132 projects in 72 companies), the number of companies that followed each type of process is different from sum of companies and different from sum of cases. A same company can follow more than one type of process and also a same company can have more than one case analyzed following the same type of innovation processes.

innovation evaluation tools were inadequate to evaluate radical innovations with greater uncertainties. To improve the likelihood of obtaining approval for an idea, employees must therefore develop their idea as far as possible before registering it in the formal system of the company.

The final finding is associated with different ways of treating uncertainties in innovation processes. On the one hand, uncertainty management corresponds to a specific activity within a project. On the other hand, uncertainty shapes the structure, the sequence, and the content of the innovation process.

In the following subsections, we will present and discuss each one of the eight types of innovation processes that emerged in our field investigation.

4.1. Process 1. Traditional process: from idea to launch

The most common process is the traditional model (Fig. 1). This process is more common in large companies that mass-produce for inventory; sales occur after production. We found that the traditional process was used in 53.0% of the cases in our research. The traditional process is typical for frequent incremental innovations that consume a reasonable time and resources; by frequent and reasonable, we mean a number of projects and an amount of time and money that justifies a managerial system dedicated to the projects. The traditional process is typically used by companies with a well-structured innovation process: on the one hand, it makes incremental innovation easier; on the other hand, it inhibits radical innovations, particularly those related to a market that is forming, as opposed to a mature or a nonexistent market. The first formal move in the traditional innovation process is idea registration using a formal tool (typically a computerized system in medium and large firms), and the process is completed when the product (or service) is available for sale. In fact, there is no convergence in the literature on what completes this type of process, whether it is the launch or sales. For purposes of simplification, we are not considering the product life cycle (PLC) here; we are assuming that PLC management is led by another team. That matter deserves its own specific research.

This traditional process addresses uncertainties sequentially. First, it tries to manage broad market uncertainties with tools such as market analyses and business plans and by prioritizing the ideas and plans that are most likely to be successful. Second, this process attempts to manage technological uncertainties during the conversion phase, in which the company can utilize tools such as concurrent engineering, project management techniques, consultants, universities, and technological centers to aid development and to mitigate uncertainties. The final stage, which is defined by launch, diffusion or sales (depending on the author), is not well developed in the literature. In the traditional process, this final stage does not require an accurate definition because most of the uncertainties have previously been analyzed enough to allow for a managerial decision to allocate resources to launch the product. In that sense, a company can successfully employ this process when it is able to linearly manage uncertainties according to some "package" (e.g., initial feasibility analysis, market analysis, and technical development).

As expected, the majority of cases (53.0%) analyzed fit here. Embraco's development of the NK compressor, Petrobras's process development for oil refineries, and Brasilata's easy-open can for chemical products (such as paint) are some of the many examples. We found this process in a hospital and in engineering consultancy firms; indeed, it was found in 46 out of the 72 companies in which innovation projects were investigated. Incumbent firms have strong processes using incremental innovation with the aim of improving their products to sustain a given competitive position.

The main contingencies that appeared to be associated with this process are a medium–long product life cycle, a mature market, mature technologies, medium–high expenditures in R&D and engineering (RD&E), product improvement, product development, and production for inventory (not for order). The level of resources involved partially explains the formality of the process. To some extent, as more money is involved, the attempt to formalize the decision-making process through traditional financial indicators—such as ROI or discounted cash flows—becomes greater.

4.2. Process 2. Anticipating sales: the tailor-made approach (open order)

A good metaphor to illustrate the second process is the production of tailor-made costumes. Sales occur prior to development and production. The relationship with the client is the main contingency and sometimes includes a large service component. The second process is illustrated in Fig. 2.

From the empirical cases, we found that certain critical sales activities occur in the initial phases (during contract negotiation). In these situations, the innovation idea is jointly constructed with the client; only after this joint construction is the project formalized (e.g., order and contract). There is then a period of maturation that includes the definition of product specifications prior to the order (or sale). An example of this process occurred when the Brazilian Air Force demanded that Embraer develop a military cargo plane. Although some resources are allocated during initial negotiations, once the order is formalized, an important level of human and financial resources is allocated to product development. The client pays for the development before

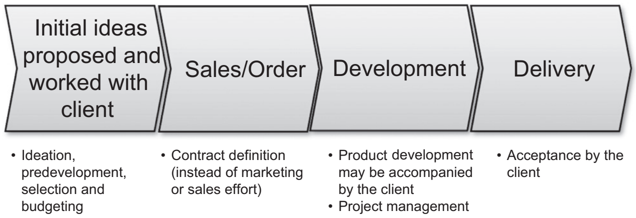

Fig. 2. Anticipating sales: the tailor-made approach (open order).

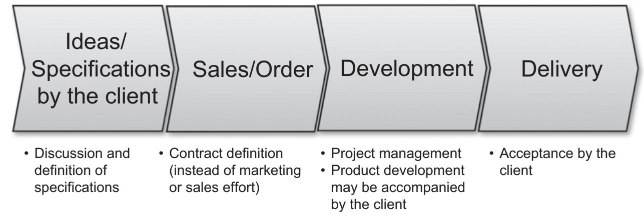

Fig. 3. Anticipating sales from a given client specification (closed order).

the delivery of the product, anticipating income for the company compared to the traditional process (process 1). Thus, the client finances the development of product and process. The delivery of the product ends the process.

Uncertainties are associated with this process in several ways. First, some uncertainties are related to the idea construction with the client. To obtain the order, the company must manage the client's uncertainties regarding its own needs, how to translate these needs into product requirements, and pricing. Second, by contrast with process 1 (traditional), the uncertainties related to diffusion (or sales) are mitigated at the beginning of the process, before the project formalized with a contract. Finally, there is uncertainty linked to the company's capability of developing the product: revenues will not occur if the company fails to develop the product, and penalties are normally defined in the contract for such failures.

This process represents 6.1% of our sample and was found in 6 companies, in projects such as Orange's systems for their large clients, differential locker 4×2 vehicle transmissions developed for Fiat by Fiat Powertrain (FPT), Linea Laura's design development and production of clothes for fashion companies, V2Com's system for remote data acquisition and processing, and research institutes contracted for R&D development.

The main contingency linked to this process is the role of the client. By contrast to process 1, in which the client expends money only in the diffusion phase, here, the process starts with the client and its initial expenditure. The client starts the process instead of ending it; without a client, there is no project because the product is developed by order and not for the shelf. The process is analogous to processes described by certain production theorists, such as Wild (1977), who have introduced a typology of production systems according to—among other criteria—the position of the client in the system.

Because the firm's size and technological foundation are always possible contingencies, it is important to note that they do not explain this process, and small and medium-sized companies with different technologies also offered this *anticipating sales: the tailor-made approach* process, such as V2Com and Linea Laura.

4.3. Process 3. Anticipating sales from a given client specification (closed order)

As opposed to the previous process, the client in process 3 has a predefined specification (e.g., functional requisites or form) that the order must fit. For the vendor, this process contains neither idea predevelopment nor a maturation period for the specifications. For the firm, the selection phase involves a decision about whether to develop the product. The third process is illustrated in Fig. 3.

In this process, sales precede development. Even if specifications come defined from the client, the company may suggest new functionalities or specifications. We found cases in which companies took advantage of orders to build platforms that could be utilized in future projects with other clients.

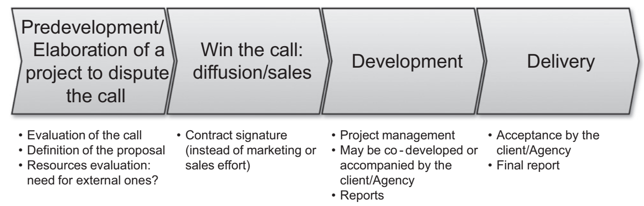

Fig. 4. Process started by a call.

By contrast with process 2 (the *anticipating sales: the tailor-made approach*), there is no uncertainty linked to idea construction with process 3. The other arguments regarding uncertainties and contingencies are similar to those discussed above for process 2.

We found this process in 5.3% of cases (innovation projects) with 7 companies, including Braskem (a new density of plastics for a specific client), Bio Manguinhos (special vaccines), CTI (websites for public institutions), Digitro (private telecom systems), and Frasle (braking parts for automobiles).

4.4. Process 4. Started by a public or private call

This process is typically associated with public requests for contract and for projects funded by resources from official agencies that are linked to public procurement for innovation as part of mission-oriented innovation policy (Edquist and Iturriagagoitia, 2012); however, it is also found in private contract bids, e.g., when a systems integrator launches a request for bids, such as in the automotive, aircraft, or home appliances industries. The call usually defines the functional requirements of the product to be developed. The flow begins with predevelopment, which consists of preparing an initial analysis of the feasibility of the project for the company (Fig. 4). In some cases, companies build a sketch of the product to better analyze their capabilities and resources to manage the call requirements.

The decision to consider competing for a call means pre-allocating resources to prepare a viability analysis with back-up documentation. Many times in this process and in the anticipating sales processes (processes 2 and 3), tasks are performed and resources are consumed before the formal process. Companies therefore have a trade-off: better preparation for the call results in a better chance of winning it but also in higher expenditures before the contract.

The main factor that explains this process is the call. From the point of view of the developer, we can interpret the call as a way to reduce market uncertainties by anticipating sales. Thus, the main activities of the innovation process occur after the sale, that is, after winning the call. In that sense, the cases analyzed show the positive effects of public procurement policy on improving innovation. By analogy, we could consider the main contingency to be the position of the client in the process, which is similar to the develop-to-order processes (processes 2 and 3).

We found this process in 12.9% of the innovation projects analyzed in 12 companies, including CNEC, Engevix, Genpro, KTY, Promom (engineering services – Petrobras bid requests), Epagri (R&D), Inovax (telecommunications), Iveco (automotive – Army bid requests), and KNBS (systems for energy management). The contingency here is the role of the client, which makes its needs public with specifications or financial conditions. The call reduces uncertainty for the developer, which is why public procurement is an efficient tool for boosting innovation in companies. The developer knows that there is a market; the uncertainty is related to the extent of the investment to bid on the contract.

Processes 2, 3, and 4 are processes that anticipate sales: the tailor-made approach (open order), a process that anticipates sales from a given client specification (closed order), and the process started by a call, respectively. These three processes have commonality concerning the role of the client. Some authors, such as Khurana and Rosenthal (1998), Kurkkio et al. (2011), and Mendes and Toledo (2012), have advocated the need to better understand the front end, whereas Katz (2011) emphasized the need for more studies on the back end of the innovation process (e.g., generically called diffusion, launch, or sales). Our results suggest that the customer's role shapes the structure and the content of the innovation process. Many scholars have argued that the client may play a key role as a co-innovator or a source of innovation (e.g., von Hippel, 1988). Our results show that the role of the client changes the way in which idea generation and diffusion are performed. Traditional approaches to the innovation process assume that the diffusion phase corresponds to the final stage of innovation (e.g., Utterback, 1971; Cooper, 1993, 2008; Hansen and Birkinshaw, 2007); the post-launch activities and other activities from the product life cycle can be considered to be additions to the innovation process. The diffusion phase is not clearly defined in these studies; in general, these authors consider it to be synonymous with the launch of the product in the market. Our results suggest that diffusion could occur in the early stage of the innovation process, as in processes 2, 3, and 4.

4.5. Process 5. Process with a stoppage: waiting for the market

Processes 5, 6, and 7 contain a stoppage; because these stoppages have different causes, we prefer to treat these processes separately. The cause of the stoppage is as important as the stoppage itself for conceptualization and managerial action.

Process 5 (*with a stoppage*: *waiting for the market*) conducts innovation efforts similarly to the traditional process from idea to launch until an uncertainty related to the market causes a temporary halt or pause after initial sales (Fig. 5).

A theoretical distinction must be made. In this type of innovation process, there is a change in structure and scope compared to the traditional process. Cooper (1993) previously noted that some rejected ideas could go to a shelf and eventually be utilized at a later date; however, the innovation process restarts with the previous idea in that case. In the process that we are proposing as process 5, the stoppage occurs after the selection and initial development of the idea. Thus, the flow of this innovation process can be divided into two segments. The first segment concerns idea generation, idea selection, development, and initial diffusion/sales. In the first segment, the product is developed to pilot or experimental plant scale. Diffusion (sales) is performed for a specific market niche, i.e., the lead users. There is a stoppage in the process because the perceived market is not large enough to justify further development, whether in production processes, product specification, or production facilities. While the process is halted, the company allocates resources to enlarge or create the market by prospecting new clients, trying to grow infrastructure and market institutions, or by creating a cognitive model regarding patterns of needs and product specifications. With perceived market expansion, by sales contracts or otherwise, the company returns to the second segment of trying to achieve an industrial and commercial scale of production.

Thus, the stoppage represents active behavior: the development activity is interrupted, but the project is not abandoned because the company directs its efforts to “create” a market. The situation is both conceptually and practically different from registering a previously rejected idea (“on the shelf”) for an eventual future use, which is passive behavior.

We found this process in 6.8% of the innovation projects investigated and in 8 companies. It was detected in two different types of business: those characterized by a chemical continuous flow and those characterized by components or subsystems in B2B supply, i.e., when the company develops a basic platform, starts selling it but must continue development to improve and adapt the platform for each buyer.

In the first case, the company performs development until pilot production. Sales start at a volume that can be supplied by the pilot plant. At that moment, there is uncertainty regarding the growth of the market, and the company decides to freeze development and hold back on investments that would be necessary to reach industrial scale (scale up); thus, the company continues its marketing efforts but freezes (or significantly slows down) the development of the scale up because the investment in a production plant normally involves a substantial amount of money, even hundreds of millions of dollars. The traditional process (Fig. 1) implies that the company considers the uncertainties to be foreseeable and the process is a tool to reduce these uncertainties throughout the phases or stages. The more advanced the stage, the more money is invested in development. This process (Fig. 5) runs until an unforeseeable important uncertainty arises: the product has been developed but the company does not consider the market to be large enough to make the investment required to scale up the development of the industrial process. Of course, this concern is typical of production processes with important economies of scale in which it is not viable to increase production capacity by small quanta.

A first diffusion stage (the initial sales) then occurs under the preliminary product and/or process specifications. During the initial sales, the company determines that there is a great uncertainty in the growth of demand. This uncertainty leads to a stoppage in the development efforts until the market variables are better understood. Based on this learning, a second development stage is performed, followed also by a second diffusion stage (Fig. 5).

Businesses based on continuous flow processes, such as petrochemical, chemical, oil refineries, and others, are confronted with

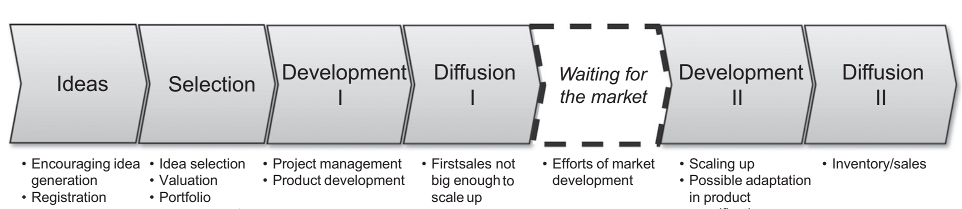

Fig. 5. Process with a stoppage: waiting for the market.

challenging decisions: whether to build a high volume continuous production plant that is normally associated with expending extensive resources. One important and common characteristic of this type of production process is that competitive production efficiency is achieved only with high volumes because of economies of scale. Additionally, in general, this type of plant offers low flexibility to produce other products, which results in a strong commitment invested in one specific innovation project. As a result of these considerations, any uncertainty related to the market for the innovative product is extremely important when deciding to scale up. If marketing uncertainties are not equated, the company continues to produce using the experimental (or pilot) plant; this offers less productive efficiency but more efficacy regarding the return on the capital invested (ROI). The company would not, in this case, scale up to industrial volumes, a development that is associated with substantial expenditures on production processes and equipment.

During the stoppage, the company continues to develop this market, trying to increase sales. The company deepens its knowledge of this particular market. When its learning leads to reduced future uncertainties, the company is then able to return the development of the industrial production process. A second development phase then occurs that is focused on building higher-scale production plants. A second diffusion phase follows, with final product and process specifications. For instance, we observed this flow in a project at Braskem to develop and produce a new high-density polyethylene; the market was not large enough to justify the investment in a production plant, and the entire market was initially supplied by the pilot plant.

Aside from continuous flow production, the innovation *process with a stoppage: waiting for the market* was also found at companies that develop components and/or subsystems to be assembled in the final products of client firms. Normally, this situation involves a B2B oligopsony in which the client must continue with development because the component or subsystem must be adapted to the client's final product. Thus, the first development is intended to obtain functional prototypes that could be used as demonstrators to support the first diffusion, the first sales. If there is no client, there is no further development and a stoppage occurs. When the company obtains a client, a second development phase is performed. This phase is focused on integration with the client product. Importantly, the second development phase is often financed by the client—at least in businesses such as automotives and aeronautics (planes). In this way, the uncertainties at that point are mitigated because either there were fewer resources previously allocated to the project or the client paid for the specific development (whether explicitly or implicitly in the price) and contracted for a given volume of production.

This type of innovation process with a stoppage was observed in projects such as the automated transmission that Magneti Marelli developed for Fiat and VW cars, Fiat Powertrain's cold start system for ethanol-fuelled engines (in reality, flex fuel engines), Coester's monorail urban train, Smar's economic capacitive pressure transmitter, Deca's deluxe twisted tap (which took 1 year in fairs and demonstrations to “build” the market), and Hospital Mãe de Deus, which developed an intermediate unit between its intensive care unit and the traditional hospital stay but had to pause until private health insurance accepted the idea.

The main contingency here is the market. More specifically, these products serve non-mature markets or markets in formation, which is typical for new products or new product concepts. However, in the case of scaling up continuous processes, the amount of money involved is also a critical part of the decision.

4.6. Process 6. Process with a stoppage: waiting for the advance of technology

This process is similar to the previous one, but the stoppage in this process is caused by a technological bottleneck within the product or process development. The first phase of the process contains the idea generation, the selection, the initial development, and the initial diffusion. When the technological bottleneck is surpassed, the final development of the product begins, and diffusion/sales close the process (Fig. 6).

To some extent, scope differences among innovation projects help to better clarify this process. Technological development and product development involve different dynamics in terms of learning, timing, and competencies. A typical product development project occurs under a set of consolidated technological knowledge. The development of a product under unconsolidated or poorly developed technological platforms may imply substantial uncertainties for the innovation process. However, foreseeing this distinction is not always simple or practical for companies. Therefore, we separated the process *stoppage: waiting for technology* (process 6) from the process *stoppage: waiting for market* (process 5).

An important characteristic that distinguishes this process from others is that its occurrence is largely involuntary because it may emerge as part of a contingency plan. In a context in which it is difficult for the company to foresee when and in which part of the project a bottleneck will create technological uncertainties, the firm normally reacts by initially allocating extra resources, planning multiple scenarios, or even increasing the error margins for timing, quality (including features and cost), and general development expenditures.

Evidence from case studies suggests that the main bottleneck is verified when the current product or process technology cannot scale up for production. During the stoppage, the company works on improving or searching for technology and might start or intensify diffusion/sales activities to increase its understanding of the possible technological trajectories. However, innovative product development may also face demands for new facilities for bench tests, new instrumentation devices, new methods and tools for design and simulation, new components and/or subsystems with special characteristics or performance, and new methods for process control, among many other demands. Furthermore, bottlenecks may stem from a dependency on outside technological improvement (e.g., from public institutions or a partner). If they do not cause development efforts to be stopped completely until a solution is found, these events force the company to launch an initial version of the innovation with a certain level of performance regarding product features or process efficiency. Once the

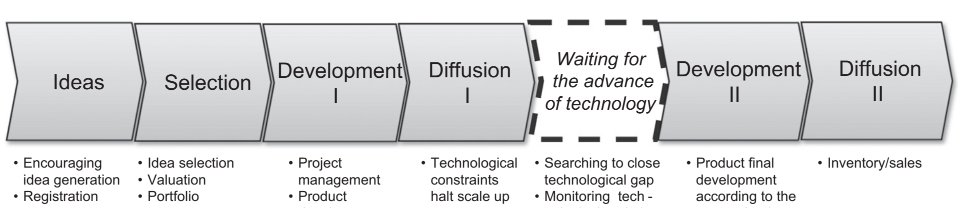

Fig. 6. Process with a stoppage: waiting for the advance of technology.

technological bottleneck is solved, a second development and subsequently a second diffusion are conducted.

This process represents 3.0% of the cases and was detected in 4 companies, including Brakem's green polypropylene from sugar cane ethanol, Ecovec's geoprocessing system for tropical diseases, Cordoaria São Leopoldo's development of special ropes for deep water oil extraction for Petrobras, and others. Although we did not research companies in the battery industry, this process could perhaps also be found in companies developing batteries for electric cars, including the Brazilian Eletrocell, the American A123 Systems (linked to the Chinese Wamxiang Co.), BYD Auto, Renault, and Mercedes.

The main contingency associated with this process is technological trajectory. This process has not been verified in projects involving mature technologies or when adapting a familiar technology to a product or process. By contrast, it is verified on the other side of the maturity or technology-readiness spectrum when integrating different complex technologies, i.e., in the case of nonexistent technologies in the beginning of the project.

4.7. Process 7. Process with stoppage: waiting for the market and for the advance of technology

Process 7 is the junction of the two previous processes with stoppages. There is a first stoppage because of technological issues and a subsequent stoppage to (actively) wait for market viability. Some companies launch an initial, and sometimes primitive, version of the product to be the first to market or to establish an initial position in the market. The first phase of the process ensues until the preliminary diffusion. Before continuing development, the company continues to search for new clients and markets. Development accelerates, which improves the product and reinforces sales efforts. This process represents 1.5% of the projects analyzed and was verified in two companies: at Nanox during the development of a bactericide nanofilm for personal care appliances and at Braskem's development of polyethylene from sugar cane ethanol. At Nanox, the problem was that the first substance utilized did not work in real-world conditions when the appliances were used. At Braskem, the market was not large in the beginning; a major automotive client was interested but requested certification of the vegetal origin of the plastic. Braskem did not expect such requirement and began searching for a way to certify the vegetal origin of the product. Although this process was found in only two projects, we decided to highlight it because of its originality; it might be useful both for understanding the project timeline and for companies to better address different types of stoppages.

In this process, there is a combination of the market and technology contingencies that were explained in the previous two processes.

Some clarifications on the proposed processes with stoppages must be made. A variety of innovation models use the “waiting for the best moment” approach to manage uncertainty. This approach implies that managers postpone important investments until particular information becomes available. For example, Cooper (1994) implicitly employed this approach at the gates: he argued that good managers should freeze a project when the required information cannot be gathered and should change their focus to other projects with less uncertainty. As proposed in this paper, stoppage points represent an evolution with respect to the “waiting for the best moment” approach. First, stoppage points do not imply that a project is frozen or canceled. These stoppages suggest that managers must perform a series of activities, such as market creation or returning to the technical development of the product or the process. Second, stoppage points reflect a proactive attitude, i.e., managers pursue particular information, shaping the future (e.g., market needs), rather than waiting for particular information to become available. Finally, stoppage points provide a managerial opportunity to address niche evolution, i.e., from a small niche, with rudimentary market needs, to a more stable market.

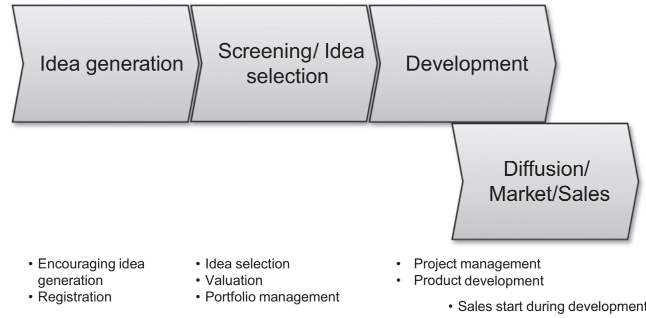

Fig. 7. Process with parallel activities.

4.8. Process 8. Process with parallel activities

We observed cases in which the diffusion/sales phase starts before the end of product development (Fig. 7). The development continues until a first version or a sample of the product is obtained. This first version does not necessarily have all of the variations (e.g., models, colors, accessories, etc.), functionalities, or quality problems solved. However, there is a version of the product available that enables the company to begin diffusion, which is performed in parallel with the remaining development efforts. These efforts may include scale up or product changes that were previously defined or considered to be a consequence of diffusion feedback. As opposed to processes 5, 6, and 7 with stoppages, in process 8, the market and/or technological uncertainties do not justify pauses in development efforts.

Parallelization here means the shortening of time to market and the reducing market uncertainties because the more definitive version of the product is launched after a test in the real market. It is not expected that a pharmaceutical company will test drugs in the market, nor will an aircraft producer launch a plane deliberately to modify it some months later; in these cases, the costs would be prohibitive. Costs in this example are defined broadly to include social responsibility and company image. This process represents 11.4% of the cases and was found in 14 companies and particularly with fashion companies (garments and shoes) and technology companies (software and some types of hardware). First, in fashion companies such as Grendene, the primary challenge is to push the product to market before it is pirated; diffusion is anticipated to prevent or to postpone other firms from copying the style and, simultaneously, to reinforce the company's trade image as a fashion leader. Grendene's salespersons begin sales activity based on a standard lot; scale development continues in parallel. In these cases (particularly for plastic or rubber shoes), it is necessary to make reasonable efforts to achieve an optimum productive scale because it is necessary to develop specific tooling for each shoe size. Thus, if the company waits for all of these processes to be completed, they will lose an important window of time in the context of short life cycles (approximately 3 months). Second, in technology companies, it is important to be the first to launch a new technology, and many software houses, such as Buscapé (internet), E-Brane (internet), ICE (software – intelligent surfaces), and iVE (internet) often launch a “beta” version of a product and continue developing it, launching new versions or updates of the same product free for their clients. These updates are neither a recall nor simultaneous engineering (which occurs in the development phase); they represent a strategy to occupy the market. The process with parallel activities may be used to create demand, to test solutions, to obtain suggestions, and to improve the product in a final version. Development activities may be strongly rearranged, depending on the feedback from the beta versions. This process was also found in other industries, such as in the development of a compressor for cooling chips by Embraco, in the development of applications for silver nanofilm for many different surfaces by Nanox, in the development of small printer and automation systems for retailers and shops by Bematech, in the development of an intelligent system for call recording and analysis by Digitro for the Federal Police.

5. Implications for theory, practice and public policies

Our empirical results provide a series of insights concerning the contingency approach for innovation process management. We have identified the different ways in which successful firms organize their innovation processes. Firms tend to have different innovation processes according to different innovation projects. Our research has highlighted eight different innovation processes. These processes are different in terms of structure and content, by contrast with the dominant literature based on the fixed-linear sequence of activities symbolized by the chain “from idea to launch”. The understanding that models other than the traditional one are possible and sometimes desirable has several implications for theory, practice, and public policies.

5.1. Implications for theory and research

Some considerations should be discussed about the typology. We consider that innovation management is closely linked to uncertainty management. The better the uncertainties are managed, the better the project is run. The following considerations involve uncertainties and the challenges that they present for innovation project management. The first consideration is about the hegemony of the traditional model (Fig. 1). This dominance is expected because most of the projects are incremental, and there are also many radical innovation projects in mass consumer goods that fit well (more or less) with the traditional model. Thus, there is a large field for a process that fits well for projects in an ecosystem characterized by low uncertainty.

The second consideration concerns the position of the client in the process. There are many businesses and many innovation processes that are initiated by an order, when the sale precedes the larger effort of product development. In these cases, a key issue is to intensify capability building to search for and to set up orders with potential clients. In addition, our findings show how the role of the client changes the way in which idea generation is performed.

Third, we showed that certain complex innovation processes may be stopped to wait for market growth, to wait for technological improvement, or both. Stopping does not mean abandoning the project but instead refers to a breakdown in either the development phase or the diffusion phase. Thus, increasing key uncertainties regarding market and/or technology stop the project, but not at its conclusion. The stoppage in the process may be seen as a way of addressing uncertainties: it is linked to a search to clarify a key uncertainty on market and/or technology. Finally, there is also a question on the linearity of the innovation processes. This important question was not our research question; to some extent, we have assumed a linear sequence of activities, even if the order of activities can change. However, the process with parallel activities challenges this linearity.

In summary, our contribution improves the knowledge about the way companies organize their innovation projects that goes beyond the fixed sequence one-size-fits-all traditional model. Similarly to the evolution of the debate on public policy (from the linear model to the systemic view of a national or sectoral innovation system and beyond), this study helps clarify that there are other processes and rationales regarding innovation in companies other than the traditional processes and rationales that may help broaden the focus and themes of future research.

The findings open a path to further research. Models for innovation processes are eminently linear, although reality frequently does not conform to linear models. A company can have different processes according to different innovation projects that depend on the contingencies and on uncertainties of each single project. We have focused on contingencies; further researches can enhance the systemic view of companies' innovation processes that are linked to specific ecosystems in which uncertainties are generated, propagated, and mitigated.

In that sense, the experience of the present research indicates at least three themes as a suggestion for further research: management of uncertainties in the ecosystem; valuation of radical projects evolved in high technological and market uncertainties; and how to represent innovation processes in a more systemic way, i.e., as a dynamic network in an ecosystem instead of a linear chain that transforms given inputs in predefined outputs.

5.2. Implications for practice

Our findings illuminate that there is no single innovation process that fits all types of innovation projects. In fact, there are innovation processes more adequate to some type of projects, i.e., processes that better deal with contingencies of a project. Thus, the findings can help practitioners in designing processes more adapted to the characteristics of their projects and contingencies, which may lead to a better allocation of resources and better efficiency in general. In that sense, three points can be remarked. First, the contingency approach and the typology of processes mitigate the risk of an interesting innovation project to be rejected (i.e. to be not selected or to be not developed) inasmuch as it does not fit in traditional innovation flow. Actually, during field research we have found several situations like that: projects that did not fit in the traditional process (“from idea to launch”) being rejected by the decision system of the company. Paraphrasing O'Connor et al. (2008, p. 251), we would say: “don't let traditional *from idea to launch* process own you”. Second, a range of innovation processes is offered, which may allow companies to better manage and perform different types of innovation projects. Third, our findings increase the portfolio of managerial approaches and strategies for managing innovation projects with high levels of technological and marketing uncertainties. Stoppages can be seen as part of the innovation process instead of a failure. Managers may proactively create stoppages in innovation processes, allowing to delay investments until the mitigation of key uncertainties. These stoppages increase managerial flexibility. To do so, during the stoppage period managers should provide appropriated support and resources for development teams to perform activities such as monitoring the technological and marketing evolutions and conducting learning experiments. In addition, our contribution shows different roles that clients may have in innovation processes; it provides orientations about which type of relationship with clients should be built and in which phase of the process.

5.3. Implications for public policies

There are certain implications for public policy as well. By investigating innovation processes, the analysis of the *process started by a public or private call* (process 4, Fig. 4) has indicated the positive effects of public procurement policy on improving innovation. The cases show that such policy induces a special type of innovation process started by a call in which sales (or the contract) are anticipated, consequently reducing market uncertainties. Public procurement changes the traditional position of sales (market, launch, client), always at the end in the traditional process *from idea to launch* (process 1, Fig. 1). However, there are some public calls that do not consider the acquisition of a product but a technological development instead. Such kind of call mitigates technological uncertainty without locating sales at the beginning of the process. In that sense, a more adequate way to incentivize companies is to link mitigation of technological and market uncertainties, which can be obtained by a well-designed public procurement project.

Therefore, this kind of well-designed procurement involves also processes 2 and 3, respectively, *anticipating sales – the tailor-made approach (open order)*, and *anticipating sales from a given client specification (closed order)*, as shown in the cases of Embraer's military cargo for Brazilian Air Force and Bio Manguinhos special vaccines for the Ministry of Health.

Public procurement is a very well-known tool for inducing innovation. Notwithstanding, the typology of innovation processes can help policy makers to think of special tools dedicated to special kinds of projects which are not started by a call or do not anticipate sales. For instance, processes with a stoppage (processes 5–7). The aim of public policies for innovation is often to incentivize the development of more projects which are involved in greater uncertainties. As we have discussed above, uncertainties are at the heart of the decision to stop a project. Public policies could set tools for reducing such uncertainties – for instance, by investing in technological developments linked to stoppages, by aiding scaling up via funding or via shared pilot plants. The key aspects here are shortening time to market and the mitigation (or the attenuation) of technological uncertainties. Certainly, a policy action concerning projects with stoppage should be carefully analyzed by policy makers – moreover for the managers of public institutions that run innovation policies, since it requires fine tuning with companies.

Additionally, public procurement could be associated with projects with a stoppage to wait for the market (Fig. 6). Projects considered strategic in a given policy could have an abbreviation on this kind of stoppage with the use of a focused public procurement.

6. Conclusions

The literature on innovation project management models has been dominated by the one-size-fits-all approach for modeling and interpreting the innovation process. This approach tends to ignore important contingencies related to real innovation projects. Many scholars and practitioners have built their mindset on this approach and ignore that a number of important factors may shape an innovation process and demand new management approaches and ways to organize innovation. Although several authors have shown dissatisfaction with the one-size-fits-all approach, a contingency approach to innovation models has remained an important gap to be filled.

We have addressed our research based on the following research question: Which configuration of innovation processes is appropriate for which situations, and what is the rationale behind this choice? We observed successful innovation projects that have followed different flows from those described in the literature. The literature shows some models that were discussed in the beginning of this paper. These models are similar in their sequence of main activities: idea generation, selection, development, diffusion/launch/sales. We called this sequence the *traditional model – from idea to launch* (Fig. 1).

This traditional model has been criticized seeing that radical innovation should be analyzed with tools other than the financial tools that are largely utilized for the evaluation of incremental innovation, including return on investment (ROI), discounted cash flow, and net present value. However, there is no criticism of the process itself; that is, the literature accepts the fixed linear sequence that is stylized in Fig. 1. Our research question was set to challenge the linearity of the fixed sequence, i.e., idea generation – selection – development – diffusion/launch/sales.

We undertook a large number of case studies since we wanted the following: (a) to have a sufficient number of cases to converge on a proposition regarding our research question, and (b) to have multiple examples of each process so we could understand the rationale behind it. By examining these case studies, we were able to propose the typology of the eight types of innovation processes and the contingencies that explain each one of them.

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